

# **TENNESSEE BUREAU OF INVESTIGATION**

## *Forensic Services Division*

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### Forensic Chemistry Standard Operating Procedure Manual

#### Sampling

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## **11.0 SAMPLING**

### **11.1 Application**

The TBI FCU has developed several sampling schemes in order to satisfy ISO/IEC 17025:2017 and AR 3125 requirements as well as to ensure the diverse populations encountered in evidence submissions are sufficiently analyzed to satisfy customer needs.

This chapter will provide guidance for determining members of populations in evidence submissions as well as sampling guidelines for those members. These members will be designated as “units” for clarity of reading.

Since it is impossible to anticipate every evidence scenario, some submissions will not conform to the sampling schemes outlined in this chapter. In these instances, the analyst will need to contact their supervisor and/or the customer on how to proceed. Analysts may also choose to exceed the minimum sample testing determined by these schemes.

### **11.2 Definitions**

- 11.2.1 Sampling – Taking a part of a substance, material or product for testing in order to reach a conclusion, make an inference, and report on the whole.
- 11.2.2 Sampling Plan – A sampling plan is a statistically valid approach to determine the number of sub-items that must be tested in order to make an inference about the whole population.
- 11.2.3 Sampling Procedure – A defined procedure used to collect a sample or samples from the larger whole, to ensure that the value obtained in the analysis is representative of the whole. The sampling procedure may include details about the size and number of sample(s) to be collected, locations from which to collect samples(s), and a method to ensure the homogeneity of the larger whole (or to make it so.)
- 11.2.4 Sample Selection – A practice of selecting items to test, or portions of items to test, based on training, experience, and competence.



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#### **11.3 Population Determination**

- 11.3.1 A population can be determined by factors such as color, size, shape, markings, and texture providing that all the units in the population are visually consistent with one another **and** are in the same external package. Internal packaging may be excluded as a factor in population determination depending on the sampling scheme used.
- 11.3.2 If a submitting agency itemizes evidence in separate external packages, those units will be considered separate populations even if they are visually consistent with other units in different outer packaging. The analyst cannot draw any conclusion on these units without performing a full analysis. These additional external packages must be accounted for on the report by their laboratory exhibit numbers.
- 11.3.3 **The analyst must also carefully review the submittal form and evidence details to ascertain what populations require analysis.** In circumstances involving, but not limited to, weight enhancement thresholds, multiple subjects, or “buy/bust” scenarios, the analyst may need to analyze visually consistent units as separate exhibits.

#### **11.4 Administrative Sample Selection**

- 11.4.1 Administrative sample selection is used to determine the presence or absence of legally significant substances in exhibits that do not have or will not reach weight enhancement thresholds.
- 11.4.2 This sample selection can be used for the following exhibit types:
- A single package or unit
  - All multi-unit pharmaceutical preparations that have identifiable and verifiable markings
  - Any other visually consistent multi-unit population
- 11.4.3 The analyst will report the identity of the substance (if applicable) and the quantity that was **fully analyzed** with the exception of pharmaceutical preparations. Refer to Analytical Guidelines Section 12.5 and the Pharmaceutical Identifiers chapter for further information.
- 11.4.4 For the last category in 11.4.2, the analyst will randomly select a single unit for analysis. No definitive identification will be made to the chemical composition of the remaining unanalyzed units. The analyst must also account for the additional units on the report. This provision can be extended to visually consistent units in other external packaging providing the analyst also obtains a unit count and makes **no inference** to chemical composition for these units.



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#### **11.5 Weight Threshold Sample Selection**

- 11.5.1 This type of sample selection allows the analyst to fully analyze and report multiple internal packages or units of a visually consistent population in order to exceed the maximum weight threshold possible within those units.
- 11.5.2 The analyst may use administrative sample selection if the total gross weight of all the units in the population will not meet the first weight threshold value for the substance of interest. The gross weight of the untested units must be indicated on the report.
- 11.5.3 The analyst will select units that will potentially exceed the maximum threshold. After obtaining a net weight for each unit within the selection, the analyst will complete a full analysis on each unit until the weight threshold has been exceeded taking into account measurement of uncertainty.

Refer to the Balances and Uncertainty in Weights and Measures chapter for further information about uncertainty values.

❖ **Example 1: Threshold sample selection and measurement of uncertainty**

The analyst has six plastic bags of visually consistent crystalline substance suspected to be methamphetamine. They determine that the total weight of the six bags would exceed 26 grams but not 300 grams. The analyst proceeds to test a single bag and determines the substance is methamphetamine with a net weight of 26.03 g.

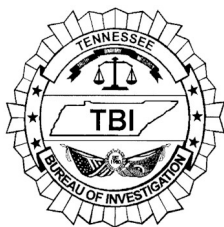
After accounting for measurement of uncertainty, the analyst decides to analyze another bag and determines the substance is methamphetamine (net weight = 10.17g.)

- 11.5.4 A gross weight of the remaining unanalyzed units will be obtained and represented on the report. No inference will be made to the chemical composition of the remaining unanalyzed units. This provision can be extended to visually consistent units under the weight enhancement threshold present in other external packaging providing the analyst also obtains a gross weight and makes no inference to chemical composition for these units.

❖ **Example 2: Threshold sample selection and external packaging**

The analyst has three itemized external evidence bags labeled 1A, 2A, and 3A. Each bag consists of a single plastic bag containing visually consistent rock-like substance. The analyst determines that the 1A is cocaine base and has a net weight of 32.76 g. Packages 2A and 3A have gross weights of 40.27 g and 31.95 g, respectively.

The analyst does not have to perform analysis on the 2A and 3A since their total gross weight would not exceed 300 grams. However, these exhibits would need to be represented on the official report.



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11.5.5 If any units within the selection demonstrate inconsistent results from the other units, the analyst shall continue analysis on the remaining units until either the threshold is exceeded or no units remain. The inconsistent unit(s) will be made into separate population(s) and represented accordingly on the report.

❖ **Example 3: Threshold sample selection with inconsistent units**

The analyst has three envelopes that contain a visually consistent crystalline substance. The crystalline substance in two of the units is determined to be methamphetamine with a total net weight of 20.45 g. The analyst proceeds to analyze the remaining unit (net weight = 7.83 g) and determines that no controlled substances are detected in this unit.

The analyst will make that remaining unit into a separate population, and it will have a different exhibit number indicated on the report.

11.5.6 If the submittal form indicates that suspected **cocaine base** unit(s) will be **federally prosecuted**, the analyst must analyze enough units to exceed 28.00 grams if enough units are available.

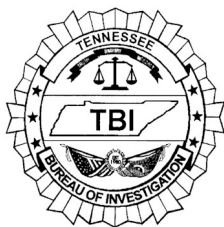
#### **11.6 Hypergeometric Sampling Plan**

11.6.1 With the hypergeometric sampling plan, the analyst can test a statistically determined number of randomly selected units in a visually consistent multi-unit population and report a result that applies to whole population with a stated level of confidence. It is typically used for a multi-unit population that will exceed a weight threshold, but the number of fully analyzed units required to exceed that threshold would be impractical to analyze. This sample selection may be used for the following exhibit types:

- Multi-unit pharmaceutical preparations that have identifiable and verifiable markings **and** will meet any weight enhancement thresholds
- Any other visually consistent multi-unit population that will meet any weight enhancement thresholds with the exception of factory-crimped injection vials (refer to Section 11.7.1 for further details.)

This sampling plan allows the analyst to state with 95% confidence that at least 90% of the total units in the population contain the identified substance.

11.6.2 The following table defines the required number of units for analysis to make an inference about the known population. Refer to the reference material at the end of this chapter for an in-depth explanation of this calculation.



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#### **Hypergeometric Distribution**

<b>Population Size</b>	<b>Required units</b>
1-9	All units
10- 12	9
13	10
14	11
15 – 16	12
17	13
18	14
19 – 24	15
25 – 26	16
27	17
28 – 35	18
36 – 37	19
38 – 46	20
47 – 48	21
49 – 58	22
59 – 77	23
78 – 88	24
89 – 118	25
119 – 178	26
179 – 298	27
299 – 1600	28
1600+	29

- 11.6.3 If a unit demonstrates inconsistent results with the other selected units, then this statistical model is no longer valid. Testing of additional units will be required to make a complete determination of the whole. Please refer to Appendix C for the appropriate units and sample sizes if one or two inconsistent units are present. The analyst must consult their supervisor or Technical Leader if three or more units are inconsistent.
- 11.6.4 The unit supervisor and/or Technical Leader may require communication with the customer(s) to determine the best course of action if a required sample size would result in excessive testing that could significantly impact laboratory output. Documentation of this communication will be maintained in the case file.
- 11.6.5 Reporting requirements for these schemes will be further discussed in the Reporting chapter.

#### **11.7 Other Sampling Procedures**

##### **11.7.1 Sample selection for factory-crimped injection vials, vape cartridges, and/or other liquids that are hazardous to remove from packaging**

- 11.7.1.1 A visually consistent population of the aforementioned units must have the same labeling **and** color of liquid present in each unit. Consult the Death Investigations chapter if these items are involved in a death investigation or other violent crime against a person.
- 11.7.1.2 Attempts at opening these units or using a syringe to remove all of the liquid present can be extremely hazardous to the analyst. For legally significant substances with



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weight thresholds, obtaining a gross weight and reporting that amount can be misleading due to the weight of the unit container itself as well as the dilution of the active ingredient of the unit.

In order to minimize potential exposure to hazardous materials, the TBI FCU will only test **one** unit from a multiple unit population.

11.7.1.3 If additional analysis is requested and approved, the following sample procedure will allow the analyst to make an **approximate** weight determination while minimizing the exposure to potential hazards.

1. The analyst will obtain a gross weight of all the units in the population.
2. As much liquid as possible will be removed using a syringe from a random selection of 10 units (if available). If less than 10 units are present, the analyst will use approximately half the units.
3. The liquid from each unit will be placed in a labeled vial (provided by the TBI FCU) that corresponds to the unit it was obtained from. These containers will be preserved with the unit and returned to the external packaging after analysis.
4. The analyst will then obtain an average weight of an empty unit container.
5. This average weight will be multiplied by the number of units present. The approximate weight of the unit containers will be subtracted from the gross weight obtained in the first step.
6. The remaining weight will be included in the item description on the report as the approximate weight of the entire liquid.
7. The analyst will then analyze the remaining units using the hypergeometric sampling plan. Consult the unit supervisor or Technical Leader for reporting guidance.

#### *11.7.2 Sampling procedure for paper exhibits*

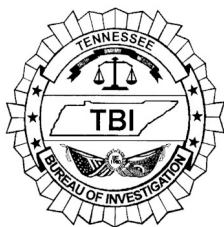
11.7.2.1 Paper square or strip exhibits may contain low concentrations or inconsistent distributions of legally significant substances. Sampling of a single square from a larger sheet may not give suitable results for a conclusive identification.

In these instances, the entire sheet of squares can be considered a single unit providing the squares are completely attached and visually consistent. The analyst will obtain a net weight of the sheet and may take several squares in various places for a single sample. The net weight of the sheet will be indicated on the report.

11.7.2.2 Visually consistent unattached paper squares or multiple sheets of paper squares will be treated as a multi-unit population and will be analyzed according to the most practical sampling scheme.

#### *11.7.3 Sampling procedure for tablet fragments or crushed tablets*

11.7.3.1 Some exhibits may contain visually consistent tablet fragments that demonstrate partial markings but not enough information to make presumptive product identifications. Administrative sample selection may be used with each fragment considered as a single unit for analysis.



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11.7.3.2 Crushed tablets that have no uniform fragmentation or markings and their respective powders will be considered as a single unit and a net weight will be indicated.

#### **11.7.4 Sampling procedure for mixtures of whole, fragmented, and/or crushed tablets**

11.7.4.1 The TBI FCU often encounters tablet submissions that include a mixture of visually consistent whole tablets, fragments with or without markings, and powders.

Whole tablets will be separated from the mixture, counted, and administratively sampled. The remaining material will be accounted for in the case notes. If no whole tablets are present, any clearly defined, marked fragments will be separated from the mixture and one unit will be fully analyzed. The analyst is not required to analyze the remaining mixture but must account for it on the report.

11.7.4.2 The analyst will refer to the Analytical Guidelines chapter for sampling procedures if additional analysis is requested and approved.

#### **11.8 Exhibit Preservation for Independent Testing**

11.8.1 No more than half of the available exhibit contents should be used in analysis so that independent testing by a third party can be conducted if requested.

11.8.2 However, if it becomes necessary to use the entire contents of the exhibit in unusual circumstances, the analyst shall request written permission from the District Attorney that complete consumption of the evidence is permitted following the precedents set forth in *State of Tennessee v. Gaddis*.

11.8.3 Extracts will be retained and resealed with the original evidence.

#### **11.9 References**

*State of Tennessee v. Gaddis*, 530 S.W.2d 64 (1975)

ASCLD/LAB-International. *ASCLD/LAB policy of Sampling, Sampling Plans and Sample Selection in the Drug Chemistry Discipline*. Effective date: March 1, 2012. AL-PD-1018-Ver 2.0.

SWGDRUG. *Methods of Analysis / Sampling Seized Drugs for Qualitative Analysis*. Version: July 7, 2011.

ENFSI (European Network of Forensic Science Institutes). *Guidelines on Representative Drug Sampling*. 2009.

ASTM. *Calculating Sample Size to Estimate, With a Specified Tolerable Error, The Average for a Characteristic of a Lot or Process*. Designation E 122 – 00.

ASTM. *Standard Practice for Probability Sampling of Materials*. Designation E 105 – 10. 2012.

Frank, R. S., Hinkley, S. W., and Hoffman, C. G., "Representative Sampling of Drug Seizures in Multiple Containers," *Journal of Forensic Science*, JFSCA, Vol. 36, No. 2, March 1991, pp. 350-357.